those flowers in which the stamens are monadelphous, viz., Ulex, Sarothamnus, Genista, Cytisus, Ononis, Lupin, there is no symptom of nectar within the staminal tube, no space for it, and no access to the interior. In some, at any rate, of these, viz., Ulex, Ononis, and Lupin, the bees certainly resort to other parts of the flower. On the other hand, where the tenth stamen is entirely free, or where it is separated at the base, so as to give an insect access to the interior of staminal tube, as in all the other flowers I have described, there is a cavity for nectar within the staminal tube, and there is nectar within this cavity.* As regards the double aperture, viz., one on each side of the base of the separate stamen, which so often occurs, Mr. Darwin suggests that, one aperture being necessary, the law of symmetry will account for there being two.

4. Other points in the structure of the filaments, anthers, and pollen seem also to be more or less related to and to depend upon the same function of fertilisation by insects. In Ulex, Genista, and Sarothamnus, where the flower is open, and in Lupin and Lotus, where the agency of the filaments is required to drive the pollen out of the keel, the filaments are stiff. In Phaseolus, where the style performs this function, they are limp. In Lotus and Lupin, the peculiar form and growth of the second whorl of stamens, and their adaptation to this function, is most remarkable. In Pisum, Lathyrus, Vicia, Phaseolus, and Lupin, where the pollen is moist, there is an apparatus for sweeping it out. In Ulex, Genista, and Sarothamnus, where it is dusty, the flower simply opens and it comes out of itself.

5. The structure of the style and stigma is in every case adapted so as to bring the latter in contact with an entering insect. In some cases, *e.g.*, in its emergence from the spiral keel in Phaseolus, and in the recoil of the style in Sarothamnus, this is effected by a very elaborate process. But the most peculiar function of the style in many of these flowers is that of sweeping out the moist pollen of its own flower from the keel. For this purpose it appears to be furnished with hairs or bristles, placed in different flowers on different parts, but always so placed as to perform the function in question. In Pisum, and, generally, in Lathyrus, the brush is on the inside of the style; in *Lathyrus grandiflorus* on both sides; in Phaseolus all round the style, but more thickly on the side next the entering insect than on the other; in Vicia on the outside of the style; in Lupin at the very extremity; but with all these differences it is always so placed as to find the pollen and sweep it out of the variously constructed keels. In this respect these flowers remind one of the brush-clad styles of the Campanulaceæ.

6. It is scarcely necessary to repeat that the nectar is found in various parts of the flower—within the staminal tube, in the vexillum, and in the calyx. But in all cases the correlation of the parts is such that an insect seeking the nectar must touch the stigma and carry away pollen.

These generalisations, if even partially correct, seem to me to be of considerable interest, not simply as illustrations of the mode in which insects fertilise flowers by carrying pollen from one to the other, but because by connecting the facts of morphological structure with living physiological functions, they give meaning and interest to the former, and possibly indicate the direction in which the true cause of that structure is to be sought.

It is but right to add that there is one genus, *Coronilla*, which, so far as I have been able to observe it, forms an exception to the above generalisation; but I have not been able to procure sufficient flowers to enable me to state any positive conclusion with respect to this genus; and I only mention it in order to call the attention of other observers to it.

T. H. FARRER

NOTES

DURING the absence of Prof. Tyndall in America, the opportunity is being taken to rebuild the laboratories of the Royal Institution on a considerably enlarged scale.

IT will be seen from our University intelligence that Mr. E. Ray Lankester, Scholar of Exeter College, Oxford, has been appointed Deputy to the Linacre Professor of Anatomy and Physiology at the University.

THE open Scholarship in Natural Science at St. Mary's Hospital Medical School has been awarded to Mr. Alfred Tilley, and the Exhibition to Mr. W. H. Weddell. Both these gentlemen are students of the London University.

THERE are now no fewer than five separate organisations at Cambridge for the improvement of female education—all of them thriving. 1. The examination of women, senior and junior girls, and of schools managed by a syndicate, of which the Rev. G. F. Browne, M.A., St. Catherine College, is the secretary. 2. A system of lectures for women, associated with four exhibitions, and a fund for assisting governesses, managed by a mixed committee of ladies and gentlemen, of which H. Sidgwick, M.A., Trinity College, and Mrs. Bateson, St. John's College Lodge, are the treasurers. 3. A series of classes by correspondence arranged by Mrs. Peile. 4. A lending library for students, managed by Miss J. Kennedy. 5. A college for women, called Merton Hall, of which Miss A. J. Clough is the principal. We understand that this last establishment is rapidly filling. The lectures commence this week.

THE Vestry of St. George's, Hanover Square, advertised some time ago for a medical officer of health and analyst for the parish, and a considerable number of candidates have, we understand, come forward. It has been suggested in various quarters that the Vestry would do well to appoint two officers instead of one; and on this point minds are divided. While some are in favour of a double appointment (with, we suppose, double pay?) others say that the Vestry are not likely to do this, and that it is undesirable that they should, seeing that their real want is an accomplished scientific sanitarian, who will, if necessary, appoint an assistant to do the routine chemical work, just as he has an inspector to do the routine sanitary work, but who will supervise everything and be responsible for everything. It is further urged that it is absurd to suppose that chemical knowledge is not continually required from a medical officer of health, quite apart from the provisions of the Act for the Adulteration of Food and Drugs, and equally absurd to suppose that a medical man without previous special sanitary experience is at all fitted to become at once medical officer of health to so important a parish as that of St. George's, Hanover Square. We confess we have a leaning to the latter view.

AT the last meeting of the Council of the Pharmaceutical Society, it was resolved unanimously that the resolution passed in 1862, prohibiting ladies from attending the lectures, be rescinded, and that ladies be admitted as students to the lecture classes of the Society. At present but one lady has taken advantage of the privilege offered; but as soon as the resolution becomes more widely known it is probable that the liberality of the Society will be recognised by ladies, who will avail themselves of this excellent opportunity of studying practical chemistry and botany. The lectures on chemistry are by Prof. Redwood; those on botany by Prof. Bentley, commencing early in October. The chemical lectures are continued three days a week until the end of July; the botanical lectures, lasting for the same period, being delivered on two days in the week. During the summer months they are delivered in the Botanical Gardens, Regent's Park.

A RUSSIAN lady, who desires to be anonymous, but is rumoured to be "still very young, and a native of Siberia," has offered 50,000 roubles for a medical course for ladies, to be given at the Imperial College of Physicians. Classes are to be formed ostensibly for midwifery, but this will not exclude the higher studies of medicine. The course is to be one of four years' duration. The threat from Zurich no longer to admit the "unprepared Russians" proves thereby a wind that blows somebody some good. "I hear," says the correspondent of the *School Board Chronicle*, "that Madame Souslof's practice at St. Petersburg is actually undermining that lady's health."

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* I have not actually looked for and found nectar in *Onobrychis sativa* and *Lathyrus macrorhizus*, but have no doubt that it is there. I have found it in all the rest.

The nationalities represented at the International Commission on the Metric System recently sitting at Paris, are the following:—Great Britain, Germany, Austria and Hungary, Bavaria, Belgium, Denmark, Spain, France, Greece, Italy, Holland, Portugal, Russia, the Papal See, Sweden, Norway, Switzerland, Turkey, Wurtemburg, United States, Chili, Argentine Republic, Colombia, Equador, Hayti, Nicaragua, Peru, San Salvador, Uruguay, Venezuela. We believe, though it is a fact not generally known that Her Majesty's enlightened Government at first refused to allow England to be represented!

The foundation stone of the New Watt Institution and School of Arts, Edinburgh, was laid on Wednesday, 9th inst., in Chambers Street, the spacious new street which runs on the north side of the College, and in front of the Industrial Museum.

The vestry of Lambeth have appointed Mr. James Muter, F.C.S., analyst to the borough.

Dr. J. E. Eddison will deliver a course of eight lectures on "The Physiology of Circulation and Respiration," in connection with the Leeds Philosophical and Literary Society. The lectures will be strictly elementary, and as much practical illustration as possible will be introduced. The following single lectures will also be delivered during the ensuing season:—"Hill and Valley Sculpture," by Prof. Archibald Geikie, F.R.S., November 5 and 7; "The Meteorology of the Sun in connection with that of the Earth," by Prof. Balfour Stewart, F.R.S., December 3; "Radiant Light and Heat," by Prof. Balfour Stewart, December 13; "The Sense of Hearing," by Michael Foster, M.D., F.R.S., January 21, 1873; "The Primitive Social Condition of Man," by E. B. Tylor, F.R.S., February 4; "The Exploration of Moab," by the Rev. Canon Tristram, F.R.S., March 4; "On some new Phenomena associated with Magnetism," by W. F. Barrett, March 18.

The following is the syllabus of the twenty-third session of the Manchester Scientific Students' Association:—The Physiography of Europe during the Pleistocene Age, by W. Boyd Dawkins, F.R.S., October 14. On the Glandular Hairs of the Fraxinella, Nettle, and Malpighia, by Charles Bailey, October 21. On Comparative Anatomy, by Herbert W. Oakley, October 28. On the History of a Mountain, by John Plant, November 4. On Meteors and Meteorites, by Rev. Joseph Freestone, November 18. On Horology, by Thomas Armstrong, December 2. And the following syllabus of papers is announced to be read at the Microscopical Club:—Glandular Vegetable Hairs, first paper, by Charles Bailey, October 3. On some Improvements in Oxy-hydrogen Illumination as applied to Microscopic Objects, by John Barrow, October 24. The Tetraspores of the Algæ, by John Hardy, November 14. The Polyparies of the British species of Hydrozoa, by Thomas S. Peace, November 28. The Micro-Spectroscope, by John Angell, December 12.

During the latter part of September, we learn from the *Times of India*, Bombay was visited by terribly destructive rains, causing not only serious injury to property, but great loss of life. Among the many instances of destruction on September 19 was that which occurred at the Library of the Asiatic Society—the largest collection of books, perhaps in India. The library is located in a series of rooms in the northern wing of the Town Hall, and before the commencement of the monsoon the roof had, as usual, been inspected, and, as it was supposed, made thoroughly water-proof. Whether owing to bad repairs, or to the excessive force of the downpour, the water found its way into one of the rooms—the room in which the librarian has his office—and completely saturated and more or less destroyed about three thousand volumes, chiefly works on jurisprudence. The expensive illustrated books, which are kept in the same room, fortunately escaped the general drenching. The injured volumes were spread out in the Town Hall to dry, but it is feared that the larger number of them are totally destroyed.

Auroræ boreales were visible on the 3rd of August at Stettin and Cracow, on the 4th at Emden, on the 8th in North America, on the 9th at Emden and Thurso, on the 15th at various localities in England and Stettin. On the 7th of August a smart shock of earthquake was felt at Innsbrück, which was followed by three more on the 8th of the same month.

On the 9th and 10th of September a severe hurricane passed over the islands of Guadaloupe, Martinique, Dominica, St. Kitts, Barbadoes, &c. Sixteen vessels, including the steamer *Isleman*, was wrecked at Martinique, and several lives lost. Every vessel in the port of Dominica was struck to pieces, and there also many lives were lost. Several ships were driven on shore at St. Kitts. The gale lasted all day on Tuesday, the 19th instant, the barometer commencing to fall from ten o'clock on the previous morning.

The following is from the *Athenæum*:—A singular controversy has occurred at Constantinople. The Government have determined that instruction in the Imperial School of Medicine shall be given in Turkish, and have removed all the professors who cannot speak the national language. Of course this has occasioned an outcry on the part of the friends of those French-speaking professors who have spent many years in the country and have not chosen to acquire its language. The Turks say they started their school as a national school, and not as a foreign one; that the pupils receive inadequate instruction from its being conveyed in a foreign language; and that they have not been supplied, as they expected, with manuals in Turkish. The authorities have, therefore, determined to run the risk of the change, and attempt to get for this school, as for others, books and teaching in the vernacular. They maintain that, as medicine has for ages been taught in Arabic, it can be taught in Turkish.

The *Moniteur Scientifique* informs us that at Proskau, in Upper Prussian Silesia, near the Prussian-Polish frontier, an agricultural college on a large scale has been established by the State, in which everything relating to agriculture, horticulture, arboriculture, and the rearing of cattle, horses, bees, and poultry is practically taught. In addition to several smaller lecture-rooms, there are two large amphitheatres, which will accommodate 200 students each; three separate chemical laboratories; a large distillery; beetroot sugar works; model brewery; museum for mineral and botanical collections; collection of agricultural implements; library containing 6,000 volumes; four farms. 5,000 hectares of forest land, and 4,000 hectares (= 2·47 acres to the hectare) of arable meadow land are attached to this institution, in which instruction is given by a staff of twenty-four professors. Proskau has 1,900 inhabitants, of whom 1,500 are Poles.

The *Times of India* of August the 16th states that an agricultural society, to be called the "Bombay Presidency Agricultural Society," composed of influential gentlemen, has been organised in Bombay. The object of the society is to diffuse agricultural knowledge amongst the people in the Bombay presidency, by establishing a journal and issuing separate tracts on agriculture in Marathi and Guzerati, and, if possible, by founding schools for this special purpose. The journal and tracts will supply a want that has been felt for some time past, and the new society is one that ought to succeed, and, if properly managed, will be sure to be of immense service in the Bombay Presidency.

WE learn from the *Garden* that the directors of the Alexandra Park Company have requested Mr. M'Kenzie to prepare a scheme for establishing a school of horticulture, for which purpose about twenty acres of the grounds attached to the building will be set apart. As we have no school of horticulture in this great gardening country, we hope something more may come of this than of its short-lived and feeble forerunners.

THE Portuguese *Jornal de Horticultura Pratica* announces a forthcoming "Flora" of that country, by Señor Barao de Castello de Piava, who was formerly Professor of Botany in the Academia Polythenica. Great things are expected from the new work, in which the subject will be brought up to the level of the knowledge of the present day, including all the discoveries which have been made since the time of Brotero, whose once celebrated "Flora Lusitanica" is now seldom to be met with for sale.

A NEW *Révue des Sciences Naturelles* has recently been started at Montpellier under the management of MM. Dubreuil and Kecker, to be published every three months.

WE learn that the publication of the *American Journal of Conchology* has closed with the completion of its seventh volume. This quarterly, edited by Mr. George W. Tryon, has appeared under the auspices of the Academy of Natural Sciences in Philadelphia, and has included, from time to time, a great many very important conchological monographs, chiefly presented to the Philadelphia Academy, many of them accompanied by coloured plates. Hereafter, such communications will be published in the Journal of the Proceedings of the Academy itself.

THE Second part of the *Quarterly German Magazine*, just received, contains translations (still into very indifferent English) of only two articles: Dr. J. Rosenthal on Electric Phenomena, and Prof. de Bary on Mildew and Fermentation.

Les Mondes has a long description, with illustrations, of the new "Horloges electriques" of M. C. F. Milde, the principal of which is a commutator for distributing the hours in all directions. It consists of an electro-magnet proportioned to the requirements, whose armature, at the moment of attraction, acts upon the arm of a lever, which governs a sector, whose centre of rotation is upon a pillar.

AN apparatus has been recently devised in Germany for obtaining specimens of water at any desired depth of the ocean. A strong, heavy vessel, entirely closed and empty, has a valve through which water may be admitted, but which is only put in motion by means of powerful electro-magnets connected therewith. These magnets are also connected with a wire which accompanies the rope, by means of which the apparatus is lowered from the ship. When the empty vessel, which is in fact a plummet, has reached the required depth, an electric current is sent from the battery on shipboard to the coils below; the magnetism thus generated opens the valves, and the vessel is filled and ready to be drawn up.

ACCORDING to the correspondence of the *New York Herald*, an ingenious plan has been adopted by Prof. Agassiz's expedition for determining how far the submarine regions are pervious to light. A plate prepared for photographic purposes is inclosed in a case so contrived as to be covered by a revolving lid in the space of forty minutes. The apparatus is sunk to the required depth, and at the expiration of the period stated is drawn up and developed in the ordinary way. It is said that evidence has thus been obtained of the operation of the actinic rays at much greater depths than hitherto supposed possible.

THE BIRTH OF CHEMISTRY

II.

Thales of Miletus—Later beliefs in his doctrine—Anaximenes—Empedokles—Herakleitos—Anaxagoras—Demokritos—The Atomic Theory—Aristotle—The Ethereal Medium—Transmutation of the Elements—The Four-element Theory—Mode of interpreting it—Cause of the absence of Natural Science among the Ancients.

THE elements of the Greek philosophers were, as we shall presently show, rather *principles* than elements in the sense in which we speak of the sixty-five elements now known to chemistry. There was a marked tendency in the earliest period of Greek philosophy to make one element or principle fundamental, and to evolve the other elements and the world from it. Thales, of Miletus, who lived in the sixth century, B.C., and who was called "the first of natural philosophers" by Tertullian, and the "first who inquired after natural causes" by Lactantius, affirmed that water was the first principle of things, perhaps, according to some writers, because Homer had made Okeanos the source of the gods. At least we are reminded of the boundless watery chaos of older cosmogonies. This doctrine of Thales was not without its supporters during the Middle Ages, and, indeed, the convertibility of water into earth and air was not absolutely disproved until about a century ago. One of the ablest supporters of the dogma was Van Helmont (b. 1577, d. 1644), who affirmed that all metals, and even rocks, may be resolved into water; animal substances are produced from it, because fish live upon it; and vegetable substances may be also produced from it. This last assertion he endeavoured to prove by what would appear to be a very conclusive experiment in those days, when neither the composition of the air nor of water was known. He took a willow which weighed five pounds, and planted it in two hundred pounds of earth, which he had previously carefully dried in an oven. The willow was frequently watered, and at the end of five years he pulled it up and found that its weight amounted to one hundred and sixty-nine pounds and three ounces. The earth was again dried, and was found to have lost only two ounces. Thus it appeared that 164lb. of wood, bark, roots, leaves, &c., had been produced from water alone. Hence he inferred that all vegetables are produced from water alone; not knowing, as was afterwards proved by Priestley, that a constituent of the atmosphere called carbonic acid had furnished the solid part of the tree, although, indeed, there was much water with it. Boerhaave devotes a page of his big book to a discussion of "whether water be convertible into earth." He concludes that the small earthy deposit observed when rain-water is distilled, arises from the particles of dust which had settled on the water before its introduction into the distilling vessel. Mr. Boyle had previously affirmed that "a very ingenious person, who had tried various experiments on rain-water, put him beyond all doubt about this transmutation, for he solemnly affirmed, on experience, that rain-water, even after distillation in very clean glasses, near two hundred times, afforded him this white earth." Finally, Lavoisier, in 1770, communicated to the *Académie des Sciences* an elaborate paper, "On the nature of water, and the experiments by which it has been attempted to prove the possibility of changing it into earth." In this he conclusively proved that water cannot be changed into earth, although it be distilled backwards and forwards for many successive days. Here then we find the old Thalesian theory at last disproved, but not before it had endured for twenty-four centuries; and this is by no means a solitary example of the permanence of old ideas. We shall become acquainted with yet older theories, which are still admitted, and which seem to be essential to physical philosophy.

On the other hand, Anaximenes regarded air as the primal element, Herakleitos fire, Pherekides earth, and some philosophers grouped two elements together. Anaximenes held that clouds were caused by the condensation of air, rain by the condensation of clouds; he appears to have clearly connected condensation with cold, rarefaction with heat. Archelaus affirmed that air when rarefied becomes fire, when condensed, water. It was very generally believed during the Middle Ages that water when boiled was converted into air. Empedokles introduced the idea of four distinct elements—earth, air, fire, and water, not capable of passing one into the other, but forming all things by their intermixture. These elements are acted upon by two principles, a uniting force of amity, a separating force of discord, corre-